Long Lake Hydroelectric Plant, Spillway Dam
Spanning the Spokane River
Ford Vicinity
Lincoln and Stevens counties
Washington

HAER No. WA-33-A

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Western Regional Office
National Park Service
U.S. Department of the Interior
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Location:	Spanning Spokane River, .5 mile east of intersection with Washington State Route 231, ca. 5.0 miles south of Ford, Stevens and Lincoln counties, Washington
Date of Construction:	1915
Architect/Builder:	The Washington Water Power Company
Present Owner:	The Washington Water Power Company
Present Use:	Hydroelectric power generation and transmission
Significance:	The Long Lake hydroelectric facility is significant as one of the earliest and, for many years, largest hydroelectric generating facilities in The Washington Water Power Company's electrical power generating network. It is the largest hydroelectric facility on the Spokane River. Its construction played a vital role in facilitating the urban, industrial, and agricultural development of eastern Washington and northern Idaho. The Long Lake Dam possesses engineering significance as a reflection of advanced hydroelectric technology of the early twentieth century. It is architecturally important for the imposing Romanesque Revival style of its power house. The Long Lake Hydroelectric Plant and its setting have remained largely unaltered since original construction of the facility in 1915. The historic property was nominated to the National Register of Historic Places in 1988. Constituent elements include the spillway dam, control dam (intake), cut-off (arch dam), and the four brick operating houses situated on top of the spillway dam.
Historian:	Robin Bruce Archaeological and Historical Services Eastern Washington University Cheney, Washington
Date:	May 1992

DESCRIPTION OF STRUCTURES

The Long Lake Hydroelectric Plant is a low-head gravity plant design with a dam that creates pondage at the point where the water is used. The dam creates a head of 170 feet, and impounds 4,573,800,000 cubic feet of water. The structure is built with the spillway section across the stream and the headgate section parallel to the river flow. The turbine-generator installed nameplate capacity rating is 70.000 kw. The brick power plant is constructed in the shape of a "T," with a concrete foundation and roof. Of Romanesque Revival styling, the power plant features arched fenestration set with large recessed arched panels.

The WWP's proposed undertaking will alter character defining features of the spillway dam, including the control gates, operating houses, and operating mechanisms for the gates. These structures are described below:

The Spillway Dam

The gravity spillway dam is 250 feet high from foundation to crest, 250 feet thick at its base and measures ca. 350 feet in length, and features cyclopean masonry construction in which ca. 25 percent of the dam is large rock. The spillway dam rests on a solid rock foundation. 1

Massive curved concrete piers separate the paired control gates, with the two piers in the central portion of the spillway rising to ohservation parapets enclosed hy protective chain link fencing (see HAER Photographs WA-33-A-1, WA-33-A-2, and WA-33-A-3). Four small hrick operating houses shelter operating mechanisms and operator control panels for the eight spillway gates.

The WWP's proposed project will create new visual effects to the spillway dam as a result of removal of the four existing hrick operating houses and construction of the proposed 35 foot high cable hoist lifting mechanism. The concrete parapets above the spillway piers will be modified hy the partial removal of concrete, beginning with the parapets' arched access passages to the upriver crest of the spillway dam. The appearance of the parapets from the primary facade (spillway) will remain essentially unaltered.

Control Gates

Original design of the spillway control gates called for two fixed-wheel, vertical-lift "waste gates" (gates 1 and 2 are located on the east end of the spillway), which were installed before completion of the spillway dam in 1915. 2 In addition, the spillway was designed for four 65 foot openings that were originally designed for

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1 C. F. Uhden, "System of the Washington Water Power Company," Journal of Electricity, Vol. 33, No. 10, September 5, 1914:4.

2 "Long Lake Renovation Study–Spillway Gate Report," Bechtel Corporation for the WWP, 1990:2-1.

installation of drum gates of German design. However, because of events leading up to World War I (1917-1919), the German gates could not be obtained. 3 The project, therefore, operated without the gates until 1919, at which time intermediate concrete piers were constructed in two of the rolling gate bays. Vertical lift gates 3 through 6, each measuring ca. 25 x 19 feet, were subsequently installed in the four bays (central portion of the spillway), A timber bulkhead occupied the west rolling gate bay until 1930 when the bulkhead was replaced with two vertical lift gates and intermediate concrete pier (see Alterations and Additions section of the report).

Gates 1 and 2 vary significantly in their configuration from gates 3 through 8. Gates 1 and 2 operate by a wheel retraction device, which allows the gates to move downstream onto their seals. The system has never proven satisfactory, however, with the result that control gates 1 and 2 have reportedly not been opened since 1948, and are currently operable only with supplemental hoisting assistance. 4

Installed in 1919, Gates 3 through 6 are normally operated during excessive water flows. These gates do not feature a wheel retraction mechanism. The wheels are fixed and non-adjustable. The side seals are flexible and slide along the sealing surface when the gate is moved. 5

Gates 1 through 6 are structurally similar:

> The gates are of an unusual design wherein the upstream skin plates are not flat, but are warped between
> supports. This permits the skin to be loaded in tension along and to carry no bending moment. Gates 1
> through 6 have skin plates which are warped both horizontally and vertically to form approximately spherically shaped bulges between supports [buckle plates]. The arrangement made possible thin skin plates (3/8 and 1/4 in. throughout) and corresponding very lightweight gates [ca. 50,000 pounds each]. 6

Gates 7 and 8 differ structurally from the other six gates, in that the buckle plate skin is warped in a vertical direction only (see HAER Photograph WA-33-A-13). This design resulted in slightly heavier gates (ca. 52,000 pounds each). 7

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3 R. T. Tiffany, Washington State Supervisor of Hydraulics, correspondence to the WWP of August 155, 1928, WWP archives, Spokane, Washington

4 "Long Lake Renovation Study," 1990:2-1, 3-1

5 "Long Lake Renovation Study," 1990:3-1

6 "Long Lake Renovation Study," 1990:3-2

7 "Long Lake Renovation Study," 1990:3-1, 3-2

Because of raised pool levels (see Alterations and Additions section of this report), age, and reliability, WWP plans to replace all eight control gates with new steel roller gates beginning in June of 1992.

Operating Houses

Four brick operating houses shelter gate operation mechanisms and operator control apparatus for the eight control gates. Each of the four structures is situated above the center piers of every pair of gate openings (see HAER Photograph No. WA-33-A-2). The operating houses were constructed following completion of the dam. Erected between 1915-1918, operating house 1 is the oldest of the four structures. Operating houses 2 and 3 were constructed in 1918 (see HAER Photograph No. WA-33-A-15 for plans of those structures), and operating house 4 was completed in 1930. 8 The operating houses measure ca. 17 feet x 10 feet, with the buildings' facades facing the spillway. The operating houses are accessed from wooden side entry doors. Of eclectic styling, the flat-roofed structures feature metal-framed, multi-pane windows with concrete aprons. The curved, shaped crest of each of the four operating houses contrasts pleasingly with the linear honeycomb brickwork of the cornices. The four operating houses and the gate operating mechanisms that they shelter will be removed in order to accommodate the new cable hoist gate lifting tower.

Operating Mechanisms

The control gate mechanisms consist of an array of shafts, gears, and motors (see HAER Photograph No. WA-33-A-16) which seat and unseat the spillway dam control gates:

> Seating and unseating of the gate is brought about by simultaneous rotation of all the eccentric axles, which is accomplished by connecting all the axles through levers to a common bar, this bar being raised or lowered to cause rotation of ales. Motion is imparted to the common bars by connecting them to screws, one on each side of gate, the screws being raised or lowered by a bronze nut fixed in a bevel gear. This bevel gear is actuated through suitable gearing by a motor mounted on top of [the] gate for tbe purpose. 9

Hoist motors are General Electric three-phase, 60 cycles, 220 V., rated at 20 HP, 900 RPM, with a synchronous speed of 760 RPM. A limit switch is mechanically linked to the worm wheel shaft and connected electrically into the operating oil circuit of the hoist motor. This mechanism controls the vertical travel of the gate by opening the motor circuit at each limit (ca. 25 feet) of gate travel. 10 Each operating house originally consisted of an east and west motor and gear assembly connected by a drive shaft to a similar gear

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8 "Historical Cost for Long Lake Spillgates and Control Houses," Accounting Department, WWP, Spokane, Washington, 1992:n.p.

9 "Notes on the Design of Waste Gates--Long Lake," n.a., January 3, 1916:9. WWP archives, Spokane, Washington

10 "Operating Mechanism for Waste Gate," n.a., January 18, 1916:n.p. WWP archives, Spokane, Washington

assembly located outside the operating house. The paired motor-gear assemblies were configured to simultaneously lift each respective gate to the gated pair. In 1989, the original motors for gates 3 through 6 were abandoned in place (see HAER Photograph No. WA-33-A-11), and replaced with new drive motors at the center of the gates (see HAER Photographs No. WA-33-A-4). 11

The original specifications for the waste gate operating mechanisms indicate the type of fabrications used in the manufacture of those components and tbeir production standards:

> Main pinion shafts and intermediate shafts shall be of Open Heartb Steel, heat treated and shall conform in particular to the Specifications of the American Society for Testing Materials as adopted August 21st, 1911. All other shafting shall be of cold rolled steel. The worm gearing shall be enclosed in cast iron oil tigbt bousings equipped with ball and roller thrust bearings on worm haft and bronze thrust washers on worm wheel shafts. Worms shall be of the "Hindly" type, carbon steel, case hardened, or tempered. Worm wheel rims shall be of Cramp's Gear Metal No. 2 securely attacbed to wheel web . . . . All spur gears with the exception of gate pinions, shall have cut teeth. All bearings shall be babbited and provided with suitable oil grooves and oil chambers or compression grease cups. 12

Most of the operator electrical control panels and manual control apparatus are located inside the operating houses. These mechanisms include control gate motor selector switches, lower magnetic contactors, raising magnetic contactors, band brakes, motor clutches, gate limit transfer switches, and oil circuit breakers to gate motors (see HAER Photograpbs WA-33-A-10 and WA-33-A-11). 13

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11 Ed Schlect, Project Engineer, WWP. Personal communication May 8, 1992.

12 "Specifications for waste Gate Hoist Mechanism at Long Lake Station," December 10, 1917:n.p., WWP archives, Spokane, Washington.

13 "Operating Instructions July 30, 1957 for Long Lake Power Plant." WWP arcbives, Spokane, Washington.

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